Division of Facilities Construction and Management
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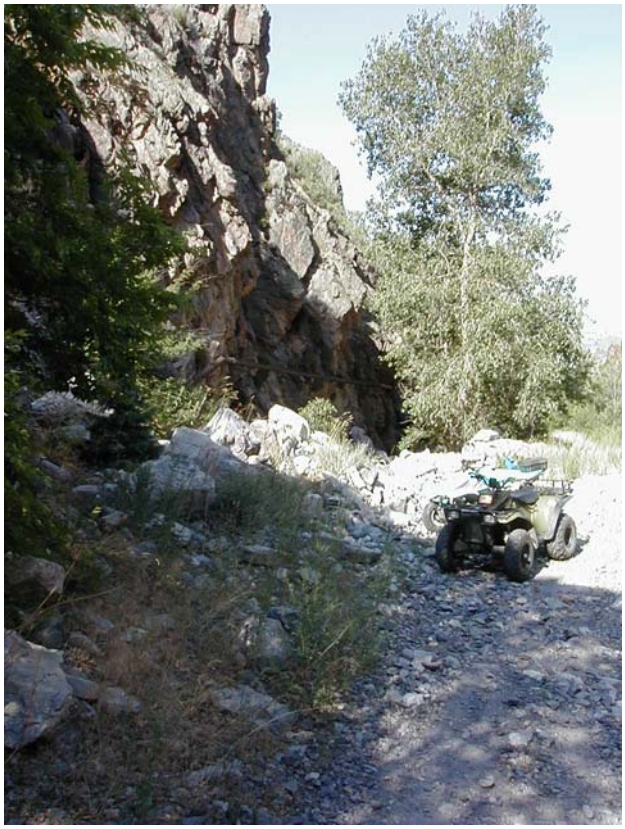
FEASIBILITY STUDY OF SLATE CANYON SOURCE DEVELOPMENT, SOURCE PROTECTION, AND SUPPLY PIPELINE REPLACEMENT



NOLTE
BEYOND ENGINEERING

September 2003

UTAH STATE DIVISION OF FACILITIES AND CONSTRUCTION MANAGEMENT

FEASIBILITY STUDY OF SLATE CANYON SOURCE DEVELOPMENT, SOURCE PROTECTION AND SUPPLY PIPELINE REPLACEMENT

FOR DFCM PROJECT NO. 00144420

UTAH STATE HOSPITAL

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EXECUTIVE SUMMARY

This report is presented to summarize the feasibility study conducted by Nolte Associates pertaining to the development of Knight Springs, the potential development of other spring sites, source protection issues of the existing Boardman Springs and replacement of the supply pipeline in Slate Canyon.

The Utah State Hospital has a water right with a diversion at the former Knight Spring #3 site. The cost to redevelop these springs is significant, given the remoteness of the site, and current inaccessibility. However, the yield potential for source development is greatest at the former Knight Spring #3 site, due to the hydrogeology of that particular area. If the goal is to maximize the flow available for the State Hospital, then the Knight Spring #3 site would provide the greatest potential to meet that goal. If the volume of additional water is not necessarily critical, then some additional groundwater could be developed at Knight Springs #1 and #2, or an alternate site in the Boardman Spring area at a reduction in cost.

The current collection facilities at the respective spring sites are generally in compliance with State source protection requirements. If new springs are developed, new Drinking Water Source Protection – Preliminary Evaluation Reports will be required to be prepared and submitted to the State Division of Drinking Water.

The Slate Canyon supply pipeline is in need of substantial upgrade and replacement. While the most costly alternative is to replace the entire pipeline, in the long term the costs will be lower and the supply pipeline will be more reliable in the interim. Additionally, the USDA Forest Service has reissued the Slate Canyon special use permit with the explicit understanding that the State of Utah will address the issues as soon as possible.

CHAPTER I
INTRODUCTION

The principal sources of culinary water for the Utah State Hospital are a group of spring sources located up Slate Canyon. The spring collection appurtenances have been updated with compliant access hatches and flow-to-waste pipelines with screen covers within the last 10 years. However, the supply pipeline is approximately 70 years old, and is currently in poor condition. There is approximately a ½ mile of the pipeline which is exposed and/or suspended on the walls of the canyon. The existing 5-1/2-inch diameter cast iron pipe is perilously thin-walled due to corrosion over the years of service. There are some existing air vent appurtenances on the existing pipeline, but no pressure control systems exist at this time on the supply line. In recent years, maintenance of the pipeline has become significant, as deterioration continues.

Of the seven (7) original spring sites, Knight Spring #1, Knight Spring #2 and Knight Spring #3 collection facilities and pipeline were destroyed over a period of several years (1977 – 1988) when a slope failure(s) and debris flow(s) went through the area, induced by higher than normal precipitation. While no flow records exist from these springs, the contribution of Knight Springs to the total supply volume available for the State Hospital was significant historically. Therefore, the scope of this study includes a feasibility analysis as to whether the redevelopment of Knight Springs #1, #2 and #3 is worthwhile, given the remote location of the one of the former collection areas, and the loss of connection to the former spring.

Nolte Associates, Inc. (Nolte) was contracted by the DFCM to conduct a feasibility study of the following issues that pertain to source development:

1. Redevelopment of Knight Springs, or other spring site development.
2. Implementation of source protection management strategies for the existing springs, including potentially new spring sites.
3. The replacement of exposed supply pipeline versus replacement of the entire pipeline.

This report will address these three elements in the order outlined above.

CHAPTER II
SOURCE DEVELOPMENT

KNIGHT SPRINGS

Water Rights

The Knight Spring water rights are 55-4108 (1.10 cubic feet per second) and 55-78 (0.11 cubic feet per second). Knight Springs and Boardman Springs are included on the same right (55-4108) with two points of diversion. If additional water is captured, water rights would need to be transferred to the appropriate point of diversion. 55-4108 is a valuable diligence right with an 1867 priority. 55-78 is a certified right with a 1923 priority.

After a thorough water right search, diversion points from those rights owned by the State of Utah – Utah State Hospital do not correlate to all of the known spring collection areas, i.e., Boardman 1, 2, 2a and 3 and Knights Springs 1, 2 and 3. The diversion locations on water right 55-4108 correspond to Boardman 1 and Knight 3 (which is not currently developed). 55-78's only diversion point is also at Knight 3. We recommend filing appropriate Change Applications with the State Engineer to match the known diversion points, and estimating spring yield from each collection area through acceptable hydraulic methods; checking all of the flows against the combined flow data from the newly installed meter.

Provo City only has two small certified and approved water rights in the lower portion of Slate Canyon. Hathenbruck Springs (55-92) is certified at 0.10 cfs or 45 gpm, and an unnamed spring (55-93) at 0.0012 cfs or 0.54 gpm. Any further claims to additional water at Boardman or Knight Springs are unsubstantiated by existing water rights.

The U.S. Forest Service also have diligence rights at Boardman #2 (55-7424 – 0.015 cfs), and at Knight Spring #2 (also referred to as Buckley Springs - 55-7423 – 0.015 cfs). These rights are used as a wildlife drinking water supply.

Hydrogeology

The geologic formations in the vicinity of the former sites of Knight Springs and Boardman Springs consist of Great Blue Limestone (Mgb), Manning Canyon Shale (PMmc), Bridal Veil Limestone member of the Oquirrh Formation (Pob), the Lower Sandy member of the Oquirrh Formation (Pol), and Moraine and Glacial Outwash Deposits (Qm).

The Great Blue Limestone Formation (Mgb) is described by Baker (1973) as a carboniferous rock of Upper Mississippian age, consisting of nearly homogeneous dark-gray to black limestone in very thin, regular beds. The limestone contains some thin beds and nodules of black chert which are most abundant in the upper part of the formation. Thin beds of black shale and/or rusty-weathering fine-grained quartzite are bedded with the limestone. The thin-bedded limestone weathers into rather characteristic pale-gray flakes and slabs that commonly have a pinkish tint.

The Great Blue Limestone is overlain by the Manning Canyon Shale Formation, and is also of carboniferous origin and Upper Mississippian age. Baker (1973) describes the Manning Canyon Shale Formation as being "...composed principally of brown to black shale but contains some beds of gray to black, generally shaly limestone, numerous thin beds of light-gray, fine-grained, light-brown-weathering quartzite, and a few lenses of orange-brown-weathering sugary sandstone and grit."

The uppermost formation at the upper end of Slate Canyon is the Oquirrh Formation, which directly overlies the Manning Canyon Shale Formation due to thrust faulting. Faulting will be discussed in more detail in the following section. The Oquirrh Formation is of Pennsylvanian and Permian age, and is described by Baker (1973) as a limestone base with overlying layers of quartzitic sandstone and limestone. The base limestone unit is known as the Bridal Veil Limestone Member, which is described by Baker (1973) as consisting "...of medium- to dark-gray, thin- to thick-bedded limestone with nodules and thin nodular beds of black chert in the upper part and with some interbedded dark-gray to black shale and a few beds of quartzite." The overlying sandstone member of the Oquirrh Formation is described as "fine- to coarse-grained thin- to thick-bedded tan to gray sandstone with interbedded gray to black cherty limestone."

The area immediately surrounding the Knight Spring #3 site and continuing eastward in a tongue-like configuration are moraine and glacial outwash deposits of varying thickness, which overly the Manning Canyon Shale and the Oquirrh Formation.

Significant structural features at the upper end of Slate Canyon are the Horse Mountain and West Aspen Grove Faults. These are significant normal faults which are typically conduits of groundwater flow in the previously described formations. The site of the original Knight Spring #3 is located just below where the West Aspen Grove Fault crosses Slate Canyon, striking north-south. The West Aspen Grove Fault is also the where the Manning Canyon Shale interfaces with the Bridal Veil Falls Member of the Oquirrh Formation. The Manning Canyon Shale acts as an aquitard through this segment of the Wasatch Range. The groundwater fracture system of the Oquirrh Formation flows in a westward direction due to the dip of the formations and the influence of surface topography. The groundwater is therefore intercepted by the West Aspen Grove Fault. Unable to flow further west due to the shale, the flow moves predominantly along the fault.

The former Knight Spring #3 location is adjacent and down-gradient to a topographic low point of the surface expression of the fault. Hydrogeologically, the Knight Spring location is a prime spring development area, within the moraine and glacial deposits which are recharged by the West Aspen Grove Fault. The conditions indicate that significant yields could be intercepted through a properly constructed collection system.

The former collection areas for Knight Springs #1 and #2 are located closer to the Boardman Spring area than Knight Spring #3. While Knight Spring #3 is nearly 3,000 feet further up the south fork of Slate Canyon, the hydrogeologic data and photos taken by the U.S. Forest Service when the line connecting the spring was severed, indicate that Knight Spring #3 had a more significant yield than Knight #1 and #2. The area in around Knight Springs #1 and #2 is currently heavily overgrown with vegetation of various types, and therefore it was not possible to locate any evidence of the former collection works. Access to Knight Springs #3 is not possible at this time.

Cost Estimate to Redevelop Knight Springs 1 - 3

The estimated preliminary development cost of Knight Springs 1 - 3 is **$486,872** (See Table I). This cost was based on the Division of Drinking Water (DDW) source development document R309-204 and other necessary infrastructure for groundwater collection listed below:

- **Perforated Pipe, Est. Cost $11,965.00** – The amount of perforated pipe, based on water rights and an assumed transmissivity, is approximately 520ft. 10 inch diameter perforated pipe costs $3.01/ft and approximately $20.00/ft for installation.

- **Impermeable Liner, Est. Cost $17,160.00** – DDW requires a minimum 10 mils thick impermeable liner that extends 15ft in all horizontal directions from all collection devices. The collection area, based on 520ft of perforated pipe and the required 15ft on each side, is 15,600ft^2. The cost to purchase and install the liner is estimated at $1.10/ft2.

- **Impermeable Soil, Est. Cost $40,425.00** – If an impermeable liner is used a minimum of 2ft of relatively impervious soil is required for cover. The cover must extend 15ft in all horizontal directions from any collection device. The total volume required, to cover 520ft by 30ft at 2ft deep, is 1,155yd^3. The cost to purchase, haul and place the impermeable soil varies from $15/yd^3 to $55/yd^3 depending on availability of the material and the distance to the construction site. For the purpose of the cost estimate an average value of $35.00/yd^3 was used.

- **Gravel, Est. Cost $12,037.00** – The perforated pipe will be placed in a trench surrounded by a coarse gravel. The trench is assumed to be 10ft deep by 2.5ft wide for a total area of 25ft^2. The total volume will be 25ft^2 times 520ft for a total of 481yd^3 of gravel. The cost to purchase, haul, and place the gravel was estimated at $25/yd^3.

- **Geo-Fabric, Est. Cost $1,911.00 –** Geo-fabric will be required around the perimeter of the trench to prevent the gravel and perforated pipe from silting in. The perimeter of the trench is 25ft with a total length of 520ft for a total of 13,000ft^2 of Geo-fabric. Geo-fabric is purchased in 15'x360' rolls with a cost of $303.81/roll. Installation is estimated at $1,000.00.

- **Collection Box, Est. Cost (3) $8,700.00 –** A collection/junction box will be used to collect water from the collection field. Each collection box will cost approximately $2,900.00.

- **Vegetation Removal, Est. Cost (3 sites) $7,500.00** – DDW requires that all deep rooted vegetation be removed from the fenced area.

- **Re-Vegetation, Est. Cost (3 sites) $3,000.00** – The U.S. Forest Service will likely require newly constructed spring collection areas to be re-vegetated with shallow rooted indigenous plants. Re-vegetation is also prudent from an erosion control perspective.

- **Hydrologic Diversion Berm, Est. Cost (3 sites) $9,000** – DDW requires that all surface water be diverted away from the collection area. The berm must be constructed immediately around the entire collection area(s).

- **Metering Device, Est. Cost (3) $7,500.00** – DDW requires a permanent flow measuring device that is properly housed and protected.

- **Transmission line, Est. Cost $227,500.00** – A transmission line will be constructed which will interconnect all of the Knight Springs, and then connect to the existing supply pipeline near Boardman Spring #3. The total distance is approximately 3,500ft at an estimated cost of $65.00/ft for materials and installation.

- **Road Development, Est. Cost $15,000.00 –** A road will have to be constructed to provide access to the Knight Spring collection areas over a distance of approximately 3,500ft.

- **Drinking Water Source Protection – Preliminary Evaluation Report $3,000.00**. This report must be completed and submitted prior to development of all new groundwater sources.

TABLE I – COST ESTIMATE TO REDEVELOP KNIGHT SPRINGS 1 - 3

Item	Amount	Units	Cost/Unit	Units	Total Costs
Impermeable Layer					
Impermeable Liner	15600	FT^2	$0.55	FT^2	$8,580
Installation	15600	FT^2	$0.55	FT2	$8,580
2' of Impervious Soil	1155	YD^3	$35.00	YD^3	$40,425
Gravel					
Area of Trench	25	FT^2			
Volume of Trench	481	YD^3	$25.00	YD^3	$12,037
Geo Fabric					
Perimeter of Trench	25	FT			
Area of Trench	13000	YD^2			
Area Per Roll(15'x360')	5400	FT^2			
Number of Rolls Needed	3		$303.81	Per Roll	$911
Installation					$1,000
Perforated Pipe					
10 Inch Pipe	520	FT	$3.01	LF	$1,565
Installation	520	FT	$20.00	LF	$10,400
Collection Box (3)					$8,700
Fence	0	FT	$10.00	LF	$0
Removal of Vegetation (3)					$7,500
Re-Vegetation (3)					$3,000
Surfacewater Diversion Berm (3)					$9,000
Flow Metering Device (3)					$7,500
10" Transmission Line	3500	FT	$65.00	LF	$227,500
DWSP - PER	1				$3,000
Road Development	3500	FT			$15,000
Construction Sub-Total					$364,698.00
Engineering & Design @ 10%					$36,470.00
Inspections & Testing @ 1.5%					$5,470.47
DFCM Soft Costs @ 12%					$43,763.76
Contingency @ 10%					$36,470.00
Other Costs Sub-Total					$122,174.23
Total					**$486,872.23**

Impact Issues

The U.S. Forest Service has indicated that an Environmental Assessment (EA) is required for the Slate Canyon supply pipeline replacement. If it is determined to move ahead with redevelopment of Knight Springs, then an EA would also need to be conducted on the impact to Slate Canyon as a result of the spring redevelopment and construction of the transmission pipeline to connect to the supply pipeline system. However, due to the geographic continuity and similarity of both projects, it is likely that one EA could address both the pipeline replacement and the spring redevelopment.

However, inasmuch as the construction will take place in the Slate Canyon watershed, construction practices and techniques should be planned and implemented with the sensitivity of the watershed in mind.

NEW SPRING SITE

As an alternative to the cost of redeveloping the Knight Springs site(s), which are located in the upper reaches of Slate Canyon, this study has considered an additional potential spring site in the area of Boardman Springs. Locating a spring closer to the existing springs would reduce the amount of supply pipeline that would be required, and could also result in lower development costs.

Water Rights

New spring locations will require a Change Application of Point of Diversion to be filed with the State Engineer's Office prior to beginning work on source development. Sufficient justification will need to be made with the State Engineer's Office to substantiate the location of a new spring in the Boardman Spring area.

Hydrogeology

The hydrogeology of the areas where Boardman Springs 1 – 3 are located indicates that groundwater is most likely to be found on the downthrown side of the Horse Mountain fault in the area. The Horse Mountain Fault is located within the Great Blue Limestone. The limestone is generally a good source of groundwater. And with the proximity of the location of Horse Mountain Fault, the Great Blue Limestone, is likely heavily fractured in the area adjacent to the fault, a good potential location for yielding a water supply. While the potential is not as great as Knight Springs #3, and with existing development of the Boardman Springs in the area already, it is assumed that some additional yield could be achieved. There is insufficient information to attempt to define the potential difference in yield, only that it will likely be less than Knight Spring #3.

Cost Estimates

Costs to develop an alternative spring site would be quite comparable to those developed for Knight Springs, less the additional pipeline (approximately $200,000).

Impact Issues

Anytime a new spring is developed in the vicinity of existing springs, the potential exists that current spring yields may be reduced by the impact of a new spring collection area. It is very difficult to be able to assess the risk of this impact in advance. But it is important to include this risk in the decision making process.

The same sensitivity issues would also apply, to development of a spring in the Boardman Springs area.

The U.S. Forest Service has indicated that an Environmental Assessment (EA) is required for the Slate Canyon supply pipeline replacement. If it is determined to move ahead with development of a new spring, then an EA would also need to be conducted on the impact to Slate Canyon as a result of the spring development and construction of the transmission pipeline to connect to the supply pipeline system. However, due to the geographic continuity and similarity of both projects, it is likely that one EA could address both the pipeline replacement and the spring development.

CONCLUSIONS AND RECOMMENDATIONS

There is significant economic advantage in not having to complete a separate environmental assessment for new spring development. Therefore while the cost of the pipeline is significant, during the process of pipeline replacement it would be wise to either redevelop one or all of the original Knight Springs collection areas, or attempt development at a site adjacent to Boardman Springs (see Figure 1).

The groundwater development potential is greatest at Knight Spring #3 because of the hydrogeologic confluence of the Manning Canyon Shale and the West Aspen Grove Fault as discussed earlier. However, the cost is significantly greater. It would be wise to closely monitor the yield from the Boardman Springs in the interim, and attempt to determine what the culinary water requirements of the Utah State Hospital actually are. Then a wiser decision could be made with respect to maximizing water production, while minimizing the economic impacts.

With the potential for development at Knight Springs #3, there may be a substantial culinary water supply surplus for the State Hospital campus. Additional water may be developed from Knight Springs #1 and #2, however, the hydrogeology indicates the yield potential is less than that at Knight Springs #3. This surplus may be sufficient enough to consider selling water to other water purveyors. With an increased available supply, the Hospital would be better positioned for possible additional storage in the future, and perhaps sufficient that the well may never be needed to supplement the spring supply. Only after Phase II construction is complete (removing irrigation demand from the system), and after reliable and consistent data from the newly installed flowmeter have been collected over a period of time, will data be available to assist in determining the actual opportunity cost of spring development at either Knight Springs 1 – 3, or an alternate site.

CHAPTER III
SOURCE PROTECTION

CURRENT DRINKING WATER SOURCE PROTECTION (DWSP) PLANS

The current DWSP Plan for Boardman and Knight Springs includes drawings of the collection areas of the existing springs from the redevelopment that occurred in 1992. The construction of the collection areas are in compliance with State Code R309-204 (Source Development for Springs). All of the pertinent elements of protection, including liner and impervious soil have been included in the redevelopment of the Springs. Therefore, no additional design/construction work to meet source protection requirements is necessary at this time. Copies of spring construction drawings are included in the Appendix.

Due to the remoteness of the spring collection areas, fences are not necessarily required, as outlined in R309-204. The fence requirement may be waived by an exception from the Executive Secretary of the State Division of Drinking Water. There are no livestock in the area, therefore the risk of contamination from the surface is rather low. Additionally, public access is restricted to Slate Canyon by a locked gate. Considering the relatively significant distances involved between the Springs and the mouth of Slate Canyon, it is a reasonable assumption that no fences will be required. Our recommendation is to request an exception to the fence requirement. The exception will not only avoid the cost to install the fence initially, but will also prevent the necessary maintenance which surely accompanies a fence at high elevations subjected to significant snow loads on a seasonal basis.

CONCLUSIONS AND RECOMMENDATIONS

From a source protection standpoint, the collections areas of Boardman Springs 1 – 3 are in general compliance with R309-204, and require no modifications, except as follows. From observations made at each individual spring collection area, it is recommended that the following changes/modifications be made:

1. Replace aluminum hatches that have holes and/or missing handles, with an aluminum compliant hatch which has more durable handles. The Junction Box, Boardman Spring #2 and Boardman Spring #2a were observed to have holes in the hatch where the handles have been removed or the hatch simply has damaged handles.

2. Raise collection box elevation of Boardman Spring #2a to a suitable height. Currently the collection box is located in the surface drainage channel, and may be susceptible to contamination from surface runoff. A suitable elevation would be 12-inches above the top of the embankment of the existing drainage channel.

CHAPTER IV
SLATE CANYON SUPPLY PIPELINE REPLACEMENT

REPLACEMENT OF EXPOSED PORTIONS OF SUPPLY PIPELINE ONLY

The 3.8 mile long existing supply pipeline consists of exposed or unburied pipe at various segments along the existing alignment totaling approximately ½ mile in length. The current 5-½ inch diameter pipeline is approximately 70 years old. Clearly, the exposed portions of the pipeline are at greatest risk for regular maintenance attention and failure. However, the entire pipeline is in a less than a desirable condition, as this supply pipeline connects the State Hospital to their primary source of drinking water.

This feasibility study will first examine the scenario of replacing only these exposed portions, and summarize the advantages and disadvantages of such a plan.

Where the new pipeline replaces the exposed portions of the existing pipeline, the proposed alignment crosses the drainage channel. Appropriate erosion control appurtenances would be designed and installed for the design hydrologic event (preferably the 100-year, 6-hour storm) at these channel crossings. From our survey information at this time, there will be approximately 4 crossings of either the primary drainage channel or tributary, auxiliary channels.

Cost Estimates

The estimated costs to replace the exposed portions of the pipeline will range between $200,000 - $220,000 (see Appendix). This replacement option will be accomplished by placing all new pipe within the existing road, and connecting back to the original pipeline as required. The new pipeline will be designed for a larger hydraulic capacity, and thus larger in diameter. Therefore at every connection to existing pipe, a reducer will need to be installed. Air vents and a pressure relief valve would be installed at appropriate points where the exposed piping is being replaced.

The most cost effective approach with the least impact to the Slate Canyon water shed will be to excavate a trench in the existing road. Even though there will be significant quantities of rock excavation the cost of other construction options becomes prohibitive and could heavily impact the Canyon during construction.

The advantages to exposed pipeline replacement only:

1. Construction costs that are 1/6 of the full replacement cost;
2. Shorter construction time.
3. Least impact to the Slate Canyon watershed.

The disadvantages to exposed pipeline replacement only:

1. An incomplete solution to present liabilities for a safe and reliable culinary water supply;
2. Postpones the inevitable complete replacement, and may require an additional independent environmental assessment;
3. Will not solve all of the current maintenance problems presented by this aged pipeline;
4. This is NOT the Forest Service's preferred approach to solving the pipeline problems.

REPLACEMENT OF ENTIRE REACH OF SUPPLY PIPELINE

The alternative approach is to replace the entire supply pipeline from each spring junction box, to the storage reservoir on the bench above the State Hospital. Placement of the new pipeline in the existing road would create much easier access to pipeline alignment in the future, and would also be protected from watershed erosion through a properly constructed erosion control appurtenances. With the full replacement option, air vents and a pressure relief valve would be installed at the optimum points along the pipeline alignment.

Where the new pipeline crosses the drainage channel, appropriate erosion control appurtenances would be designed and installed for the design hydrologic event (preferably the 100-year, 6-hour storm). From our survey information at this time, there will be approximately 13 crossings of either the primary drainage channel or tributary, auxiliary channels.

Cost Estimates

The detailed estimate to replace the entire supply pipeline is included in the Appendix to this report. With the survey completed at this time, and known challenges to be overcome during construction, our estimate is 1.2 Million.

The advantages to complete supply pipeline replacement:

1. Long term solution, likely a 50 year plus design life;
2. A supply pipeline that significantly reduces required maintenance;
3. Minimizes the State Hospital's and DFCM's liability for a safe and reliable culinary water supply.

The disadvantages to complete pipeline replacement:

1. Substantial cost of construction.
2. Longer construction period.
3. More impact to the Slate Canyon watershed.

ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The U.S. Forest Service has indicated that an Environmental Assessment will be required to address the impacts of replacement of the supply pipeline to the existing environment in Slate Canyon. Through contact with various individuals with the Forest Service and other agencies, we have determined that the scope of the required Environmental Assessment will be as follows:

1. Develop proposal for scope of work within Slate Canyon;
2. Internal agency scoping by the Forest Service;
3. Environmental Assessment;
    a. Scoping and Analysis performed by others;
4. If impacts are deemed to be significant, it will move to the Environmental Impact Statement (EIS) status; otherwise a decision will be proffered;
5. Public Review (30 days);
6. FONSI (Finding of No Significant Impact);
7. Implement.

The Environmental Assessment (EA) for spring development would be included in the analysis for supply pipeline replacement, because they are related and ultimately will be physically connected. The cost for an EA ranges between $20,000 - $60,000, so for our purposes at the feasibility stage, we have assumed a median cost of $40,000 to complete the EA and submit to the Forest Service. The time frame to complete the EA varies, but typically the process will take 6 months to a year.

The cost and resources needed to complete the EA will vary little between the selected options for supply pipeline replacement. The full exercise and analysis of the assessment will be similar in scope in both alternatives. Therefore, the cost and duration of the environmental assessment will not be a function of the option chosen. However, if during the process, a full EIS becomes a requirement, the costs will need to be reevaluated.

CONCLUSIONS AND RECOMMENDATIONS

Currently, Provo City's water rights in Slate Canyon are minimal (less than 46 gpm) as outlined earlier in this report. The Forest Service has continued to emphasize their desires that the final solution of pipeline replacement meet the objectives of both the DFCM/State Hospital and Provo City. If Provo City desires to recapture their water from the two springs in the lower canyon as a drinking water source. A dialogue should be initiated with Provo City during the design phase of the full pipeline replacement option, to determine what contribution the City may wish to make financially or otherwise. This coordination would only make sense if the full pipeline replacement option is chosen. All of the exposed portions of the existing pipeline are above Provo City's springs.

Replacement of the supply pipeline in Slate Canyon is a project of significance in size and scope, due to the nature of the conditions in Slate Canyon and the existing regulatory climate. It was

over 70 years ago when this project was constructed, and the water resource and engineering worlds have changed significantly, along with a marked increase of environmental awareness and sensitivity. However, this supply pipeline is critical to the culinary supply of water needed by the State Hospital. Eventually, the entire reach of pipeline will have to be replaced prior to complete failure. The question this report has attempted to address is whether the time is now. The principle factor affecting this decision is one of economics, given the Forest Service's preference that this issue is dealt with completely and entirely in one effort. If the resources can be acquired to do so, replacement of the entire supply pipeline is the best long term solution, and will ultimately have to occur. We can assume that costs will continue to increase, and that full pipeline replacement in several years will be more costly from an economic standpoint, and also may be more difficult from an environmental perspective, depending upon whether the regulatory climate becomes more restrictive.

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APPENDIX

Exhibit A - Cost Estimates
Exhibit B - Spring Construction Drawings

EXHIBIT A
Cost Estimates

ENGINEERS COST ESTIMATE - SLATE CANYON WATERLINE UPGRADE

22-Aug-03

ITEM	DESCRIPTION	EST QTY	UNIT	UNIT COST	TOTAL AMOUNT
1	Mobilization	1	L.S.	$85,000.00	$85,000
2	Materials Testing	0	L.S.	$0.00	$0
3	10-Inch Dia Class 51 DIP	20,050	L.F.	$45.00	$902,250
4	Import Road Base	30,000	C.Y.	$13.00	$390,000
5	Connection to Existing Collection System	4	Each	$850.00	$3,400
6	Main Channel Crossings	6	Each	$4,000.00	$24,000
7	Connection to Piping at Reservoir	1	Each	$2,900.00	$2,900
8	Aux Channel Crossings	4	Each	$2,500.00	$10,000
9	Pressure Relief Valve	1	Each	$3,000.00	$3,000
10	Air Vent Stations	4	Each	$4,500.00	$18,000
11		0	C.Y.	$5.00	$0
12		0	Each	$2,500.00	$0
13		0	L.S.	$8,900.00	$0
14		0	L.S.	$3,500.00	$0
16		0	L.F.	$20.00	$0
17		0	L.F.	$30.00	$0
18		0	L.F.	$25.00	$0
19		0	Each	$2,500.00	$0
20		0	Each	$3,500.00	$0
				SUBTOTAL	**$1,438,550**
21					
a		0	L.F.	$21.00	$0
b		0	C.Y.	$7.00	$0
c		0	S.F.	$1.25	$0
d		0	L.S.	$3,000.00	$0
				ADDITIVE ALTERNATE	**$0**

TOTAL:	**$1,438,550**
+ CONTINGENCY (5%):	$71,928
TOTAL + CONTINGENCY:	**$1,510,478**
ENGINEERING FEES - 120 DAYS - SDC:	$0
ENGINEERING FEES - SDC - EACH ADDTL DAY:	$0
GRAND TOTAL:	**$1,510,478**

Notes:

Mobilization is approximately 6%.

EXHIBIT B

Spring Construction Drawings

EXISTING STORAGE TANK

UNNAMED SPRING - PROVO

HATHENBRUCK SPRING - PROVO

JUNCTION BOX

BOARDMAN SPRING NO. 2

BOARDMAN SPRING NO. 2A

BOARDMAN SPRING NO. 1

BOARDMAN SPRING NO. 3

FORMER KNIGHT SPRING NO. 1

FORMER KNIGHT SPRING NO. 2

FORMER KNIGHT SPRING NO. 3

HORSE MOUNTAIN FAULT

WEST APSEN GROVE FAULT

BONNEVILLE SHORELINE

CORROBATE BOUNDARY

PROVO

UINTA NATIONAL FOREST

Maple Flat

Slate Canyon

Buckley Mountain

Horse Mountain

Kolob Basin Overlook

Seven Peaks Golf Course

The Peaks Ice Arena (2002 Olympics Site)

Utah State Hospital

Provost Park

Provost Sch

Eastwood High Sch

Mountain Brook Sch

Harmon Park

Adventist Sch

Wasatch Sch

Oakridge Sch

Kiwanis Park

Drive-in Theater

Bicentennial Park

Substa

Canal

Upper Union

Lower Union

Rock Canyon

Second Right Fork Rock Canyon

Road Drain

Draw

55-507

55-2481

LEGEND

PROPOSED REPLACEMENT PIPELINE

PROPOSED NEW PIPELINE

EXISTING PIPELINE (1937 AS-BUILT)

PROPOSED SLATE CANYON PIPELINE
PIPELINE IMPROVEMENTS
PROJECT LOCATION MAP

PREPARED FOR: DFCM - UTAH STATE HOSPITAL DATE SUBMITTED: AUG 2003

NO. | BY | DATE | REVISIONS

CAUTION

The engineer preparing these plans will not be responsible for, or liable for, unauthorized changes to or uses of these plans. All changes to the plans must be in writing and must be approved by the preparer of these plans.

NOLTE
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801.743.1500 TEL 801.743.0300 FAX WWW.NOLTE.COM

FIGURE NUMBER
1

SCALE
VERTICAL: 1"= XX
HORIZONTAL: 1"= NTS

JOB NUMBER
SL00090

XREFS/P2345N, ep01-cover, CANYON-ALIGN